FINAL TECHNICAL REPORT

PALEOSEISMIC INVESTIGATION OF NEWLY DISCOVERED SPLAYS OF THE HUBBELL SPRING FAULT SYSTEM, SOUTHERN ALBUQUERQUE, NEW MEXICO

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Abstract

A paleoseismic trenching project designed to investigate the earthquake history of the Hubbell Spring fault system south of Albuquerque was not able to be completed due to logistical complications.

Summary

The metropolitan area of Albuquerque has a population over 857,900 and is the sixth fastest growing urban area in the U.S. The Hubbell Spring fault system (HSFS) is a down-to-the-west, normal fault located near the eastern margin of the Albuquerque-Belen basin in the central Rio Grande rift. It is one of the longest, widest, and most active faults in the region. Recent mapping of late Quaternary scarps has revealed a longer and more complex geometry for the HSFS, with several newly identified subparallel and anastomozing fault splays (as many as eight compared to three previously mapped), a total length of 74 km (revised from 43 km), and higher estimated cumulative late Quaternary slip rates of 0.2 to 1.0 m (Figure 1; Olig and Zachariasen, 2010).

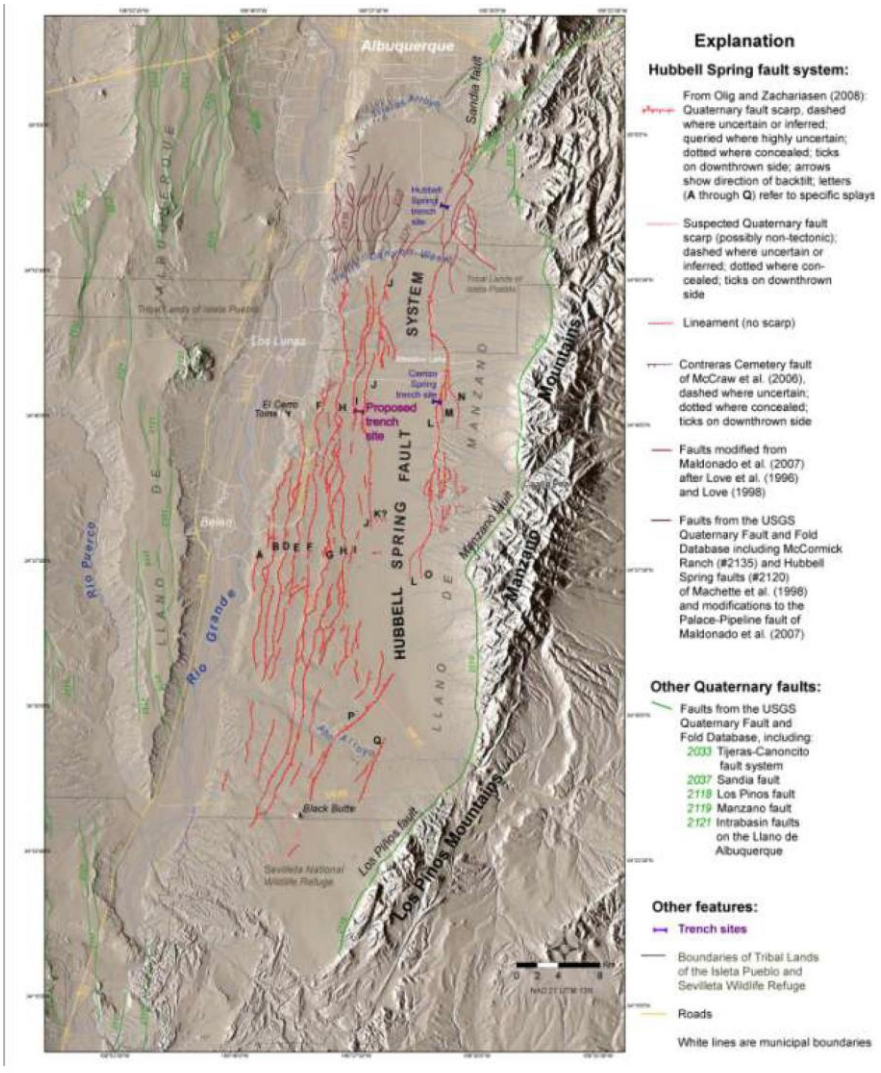
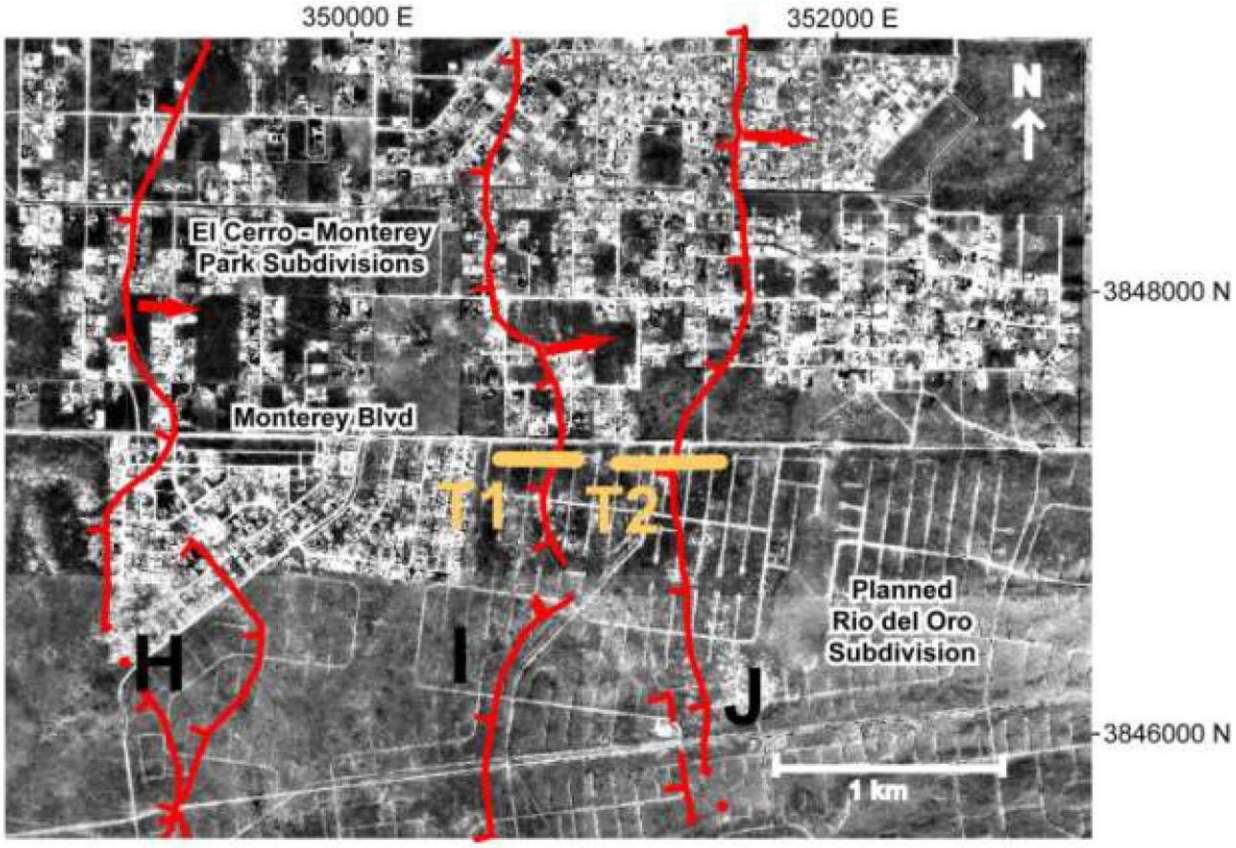


Figure 1. Map of the Hubbell Spring fault system (HSFS) showing previous and proposed trench sites in the southern Albuquerque area, New Mexico (after Olig and Zachariasen, 2010).

Unusual back-tilting in the footwall along many scarps results in large uncertainties in net vertical displacements and slip rates (Olig and Zachariasen,, 2010). Paleoseismic trench investigations on two of the previously mapped fault splays found evidence for at least 4, possibly 5, large earthquakes that occurred since 94 ka (Olig et al., 2004; 2005; 2011). The evidence suggests that the two splays ruptured together during the four largest events. However, nothing is known about the behavior of the newly identified fault splays, or how rupture patterns vary across or along-strike of this 18-km-wide and 74-km long fault system. Furthermore, until the cause of the footwall back-tilting along the HSFS is better understood (e.g., is it related to drag-folding or secondary faulting and block-tilting?), this unusual phenomenon cannot be adequately addressed in estimating slip rates. Thus, we know that the HSFS poses a significant seismic threat to the Albuquerque region, but we do not have enough information to adequately characterize the many splays of this complex fault system.

The purpose of this proposed trench investigation was to provide paleoseismic information on two of the newly mapped fault splays of the HSFS (Figure 2). The goal was to acquire information regarding the timing of paleoearthquakes, recurrence intervals, displacements per event, slip rates, and paleomagnitude estimates. Results would have provided the following data for improving seismic hazard evaluations in the Albuquerque region: (1) a better understanding of how earthquake ruptures and activity varies along strike along the same splay of the HSFS; (2) a better understanding of the cause of the unusual back-tilting observed in the footwall of some splays, which will help better constrain slip rates; and, (3) comparison of how the paleoseismic behavior varies on three splays of this complex fault system at the same latitude. The proposed trench sites are located at about the same latitude as one of the previous trench sites on another splay. Our ultimate goal is eventually to trench each of the significant splays of the HSFS at approximately the same latitude. We believe this systematic approach is the best way to better understand the overall behavior of the entire fault system and the proposed trenches in this study were intended to provide a practical and necessary next step in this ultimate goal.



Unfortunately, we were unable to complete this trenching project, due to a number of logistical challenges. These included bankruptcy of the corporation that owns the development in which we were going to excavate the trench, change in management of the development, changing company restrictions on the acceptable excavation contractors that limited us to excessively expensive excavation costs, refusal of the local shoring rental companies to rent shores without our hiring a 24-hour guard for the trench site. Even reconfiguring the project to excavate only a single trench across Splay J was inadequate to make the costs manageable, and ultimately we gave up and returned the funding.

The Hubbell Spring fault system continues to pose a hazard to the Albuquerque area and deserves further investigation, including paleoseismic investigations. With luck this can be done in the future, perhaps by people or organizations with more flexibility in staffing and subcontracting.

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